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Learning to Learn

The Art of Doing Science and Engineering

Session 6: Artificial Intelligence I



Can Machines Think?

Underlying Problems:

- Your personal ego
 - *Assets machines possess that you don't*
- Your religion
 - *Christian: God creating man in own image*
 - *Puts you in competition with God*
- Formulas vs. thinking
 - *e.g. chess programs*



What the universe is...

Greek: Democritus - “all is atoms and void”

- classical view of physics

What about souls?

- How can souls change what is going to happen?
- Can lead to discussions between the psychic world and the physical world



Expectations:

**That you can answer the question:
“Do machines think?”**

- What you think is not important
- What is your ability to intelligently express your opinions clearly



Why should I want to do this?

- If you believe that there is a fundamental difference between humans & machines, then you will be hesitant to use computers and the world will become highly computerized around you
- If you believe that machines can think, then it is likely you will attempt to misuse the capabilities of computers which will be detrimental to your career.
- The goal is to believe and disbelieve at the same time.



History of Computer Thinking

RAND

- Playing games - very structured environment. Object and rules are clear. Success can be measured. (e.g. winning at chess)
- Logic problems (missionaries & cannibals)
- General problem solvers (list processing)
- Expert systems (rule-based logic)



Expert Systems

- Gather experts & interview them
- Figure out how they make decisions
- Encode these decision rules
- Machine will then be able to solve the problem
- Similar to decision tree logic found within some medical texts (various symptoms yield a diagnosis)



What if an error occurs?

- Doctors are human and can use “due prudence” to avoid legal obligations
- If a machine gives an error, who do you sue?
 - The programmers? The company that sold you the service? Obviously can't sue the machine.
 - A program can be debugged (find bad decisions). A doctor is not so fortunate (“to err is human”).
- If a machine did diagnose you, who would write the prescription?

Can Machines Think (ala AI)?



- **What burdens can be put on the machine?**
 - Muscle-power (power tools, robots, etc)
 - So why not brain-power?
- **Poorly stated problem**
 - The real question is: “Can YOU write a program to make the machine think?”



What is a machine?

- **Can't be organic?**
- Wooden machines? Nervous systems as memory devices.
- **Jesuit priest's answer: Humans can think and machines can't.**
- The gap is getting smaller.
- Definitions are arbitrary – and negative definitions can leave you open for a contradiction in the future.
- Try a positive definition vs a negative one.



Ego and thinking...

Ego says:

- Rocks & trees can't think. Maybe animals.
- Einstein & Newton thought, but you're not at their level.
- Need to have a definition that proves that you can think



Souls...

- **If we are different from the rest of the living world... what is it?**
- Ex: cats - self-aware and self-conscious; likely that they can think
- One-celled animals can figure out what is food and can be trained. Thus, thinking not a function of a nervous system.



The whole is greater than the sum of its parts...

- Believe molecules have no friction
But large assemblies of molecules do have friction.
- Thus large assemblies can have properties that their individual parts do not possess



The failure of AI

- **Suggests that machines can't think**
- **Teller - wave-particle duality**
- Quantum mechanics: light is like both waves & particles
- **Davis & Germer:**
 - Electrons have wave-like properties
 - **Two-slit experiment (wave particle duality)**
 - QM professors can't explain why this happens



But why can't you think it?

- There are creatures that can see, smell, and hear things beyond our range
- We are built the way we are
- Then why are we offended that we cannot think in certain ways.
- Maybe humans cannot think in QM



Living with Ambiguity

Great scientists tolerate ambiguity.

Everything is not true or false; yes or no.

Life is in shades of gray...

Thus...

Machines can think and they can't.

Light is a particle and a wave.



Souls

How much does a soul weigh?

What is a soul?

Self-awareness - I believe it's more than just molecules banging together.

Thus, I believe, like Teller, that we are both these things (molecules & spirit).



More history...

Aristotle: Earth and Heavens are different and under different rules

Newton: Moon and apple motion both responding to gravity (under the same rules)

Chemistry: Originally believed organic compounds cannot be made by man. Belief is now the reverse, man can create anything within a human body “inside a test tube.”

Enough success can change belief system.



- **Something beyond the molecules that enables you to think. But if you don't know what that is, how can you program it into a machine?**

Definition of “meaning” like definition of “time” - understood, but indefinable. Then how can a machine deal with “meaning?” All assertions without demonstrations.

Life depending on a machine



- **Pacemakers**
- **Emergency wards - you are monitored by computer... better than a nurse**
- **Airplanes - better airplanes are unstable and rely on the computer as much as pilot**
- **Stoplights - works better than a policeman**



What can computers do?

- **Tic-tac-toe: 4x4 matrix**
 - Legal moves, strategy to win & to block, advantages and forcing player into disadvantaged moves
 - Heuristic rules; no fixed rules
- **Chess (Claude Shannon)**
 - How to play chess (what moves are better than others, evaluation and worth of pieces & moves)
 - Codified into machines
 - Now machines can generally beat most players



Checkers (Art Samuels)

- Blocked pieces, control of the center
- Constants of evaluation
- Perturbed the formula and had the machine play against itself (1st vs 2nd formula). Found which formulas were better than others and repeated (changing various parms) until “best” formula found.
- Machine beats human checkers champion (with 40 years of experience).



Experience and programming

- Did the machine learn from experience?
- If programmed in - isn't that what school is all about?
- Machine started out a poor player and “learned” from its experiences to become an expert checkers player
- Intelligence - isn't that learning from experience?



Artificial Intelligence

- **How would I answer these questions:**
 - What would I except as a test that a machine can learn or not?
 - What will I accept as the difference between man and machine (beyond personal/religious biases)?
- **Until you can answer these questions, you will not make much headway in AI & determining “can machines think” or can programs be written to exhibit thinking.**



Free Will & Ambivalence

- Teachers believe that “if only I can say things in the right way, then you will have to understand”
- Similar to parents & their children:
 - “If only I raise them right, they would behave right.”
 - Acts as child has not free will
 - Parents will then blame bad behavior on child’s free will.
 - Society often blames the parents for a child’s behavior
- Similar to view of crime & environment
 - “Fix” the environment and people will behave - no free will